DISTAL PROTECTION MECHANICALLY ATTACHED FILTER CARTRIDGE

Background of the Invention

1. Field of the Invention

The present invention pertains to field of distal protection devices. More particularly, the present invention pertains to devices and methods for coupling a distal protection filter to an elongate shaft.

2. Description of the Related Art

Heart disease is a major problem in the United States and throughout the world. Conditions such as atherosclerosis result in blood vessels becoming blocked or narrowed. This blockage can result in lack of oxygenation of the heart, which has significant consequences since the heart muscle must be well oxygenated in order to maintain its blood pumping action.

Occluded, stenotic, or narrowed blood vessels may be treated with a number of relatively non-invasive medical procedures including percutaneous transluminal angioplasty (PTA), percutaneous transluminal coronary angioplasty (PTCA), and atherectomy. Angioplasty techniques typically involve the use of a balloon catheter. The balloon catheter is advanced over a guidewire such that the balloon is positioned adjacent a stenotic lesion. The balloon is then inflated and the restriction of the vessel is opened. During an atherectomy procedure, the stenotic lesion may be mechanically cut away from the blood vessel wall using an atherectomy catheter.

During angioplasty and atherectomy procedures, embolic debris can be separated from the wall of the blood vessel. If this debris enters the circulatory system, it could block other vascular regions including the neural and pulmonary vasculature, both of

which are highly undesirable. During angioplasty procedures, stenotic debris may also break loose due to manipulation of the blood vessel. Because of this debris, a number of devices, termed distal protection devices, have been developed to filter out this debris.

Brief Summary of the Invention

The present invention pertains to adaptors for coupling devices to an elongate shaft. More particularly, the present invention pertains to adaptors for coupling a distal protection filter to a guidewire. In addition, the use of an adaptor in accordance with the present disclosure may allow a user to couple a distal protection filter to a number of different guidewires.

The adaptor may include a proximal end, a distal end, and a lumen adapted and configured to receive a guidewire. The adaptor may be coupled to the guidewire by a number of methods such as solder, bronze, adhesive or other technique. The adaptor may also be placed on the wire such that it can be slide along the wire to provide a floating filter. A holding receptacle may be disposed proximate of the distal end of the adaptor. The holding receptacle includes one or more grooves adapted to receive struts of a distal protection filter. In addition, a cap can be slidably disposed about the adaptor such that the cap can be disposed over the holding receptacle to substantially fix the struts in place and, thus, couple the filter to the guidewire.

Brief Description of the Several Views of the Drawings

Figure 1 is a perspective view of a tubular adaptor for coupling a distal protection filter to an elongate shaft;

Figure 2 is a perspective view of a tubular adaptor having a distal protection filter coupled thereto;

Figure 3 is a perspective view of the tubular adaptor and filter in Figure 2, wherein a cap is disposed over a portion of the struts; and

Figure 4 is a partial cross sectional view of an alternate adaptor for coupling a distal protection filter to an elongate shaft.

Detailed Description of the Invention

The following description should be read with reference to the drawings wherein like reference numerals indicate like elements throughout the several views. The detailed description and drawings illustrate example embodiments of the claimed invention.

Figure 1 is a perspective view of a tubular adaptor 10 for coupling a distal protection filter to an elongate shaft. Adaptor 10 simplifies the process of coupling devices to a guidewire by permitting a user to couple a device to a number of different guidewires. Adaptor 10 may be generally cylindrical in shape and includes a proximal end 12, a distal end 14, and a lumen 16 extending therethrough. Lumen 16 can be adapted and configured for having an elongate shaft or guidewire disposed therein. Alternatively, the guidewire may be disposed within the lumen of a seal tube 22 as discussed below. Adaptor 10 may be comprised of a generally polymeric material, a metal or metal alloy, combinations thereof, or other suitable materials.

Whether the guidewire is disposed within lumen 16 or within the lumen of seal tube 22, adaptor 10 can be coupled to a guidewire by using one of several known techniques. For example, adaptor 10 may be crimped on the guidewire, soldered, brazed, laser or heat bonded, adhesively bonded, etc. If adaptor 10 is not fixedly attached to a wire or guidewire by adhesive or the like, adaptor 10 may be merely slidably and/or rotatably attached to the guidewire.

In order to accommodate a number of different guidewires, the inside diameter of lumen 16 may be sized to allow a particular guidewire to be disposed therein. For example, lumen 16 may having an inside diameter of about 0.005 to 0.020 inches or more. In addition, the overall profile of adaptor 10 should be sufficiently small to allow navigation through the vasculature of a patient, and may be sufficiently small enough to fit within the lumen of a guide catheter or other suitable device for delivery.

Adaptor 10 can include a holding receptacle 18. Holding receptacle 18 is generally cylindrical and includes one or more grooves 20 formed therein. Grooves 20 are adapted to receive at least a portion of a strut of a distal protection filter.

A seal tube 22 having an inner lumen 24 extending therethrough may be disposed within lumen 16. Seal tube 22 may be comprised of a thermoplastic elastomer such as Kraton® or other suitable materials that may substantially prevent fluid flow through lumen 16 (or inner lumen 24). Seal tube 22 may allow adaptor 10 to become substantially sealed to a guidewire, for example by friction fit. In addition, the inclusion of seal tube 22 may prevent fluid from passing through open portions of adaptor 10.

The size and length of seal tube 22 may be used to accommodate a number of wire or guidewires.

Figure 2 is a perspective view of tubular adaptor 10 coupling a distal protection filter 26 to a guidewire 28. Filter 26 may be comprised of a polyurethane sheet disposed over a filter frame 27. The polyurethane sheet has at least one opening that may be, for example, formed by known laser techniques. The holes or openings are sized to allow blood flow therethrough but restrict flow of debris or emboli floating in the body lumen or cavity. Filter 26 may be generally cone-shaped, and have a proximal end 30 and a

distal end 32. Distal end 32 may be a narrow, "V"-shaped end and proximal end 30 may have a relatively wide opening or mouth.

Filter 26 operates between a closed collapsed profile and an open radially-expanded deployed profile for collecting debris in a body lumen. In an expanded profile, the mouth is opened and the frame expands radially outwardly to support the mouth. A number of differing configurations of filter 26 may be substituted without departing from the spirit of the invention.

In addition, a portion of the filter frame 27 may include radiopaque materials. Radiopaque materials are understood to be capable of producing a relatively bright image on a fluoroscopy screen or another imaging technique during an intravascular procedure. This relatively bright image aids the user of distal protection assembly 10 in determining the location of filter 26. Radiopaque materials may include, but are not limited to, gold, platinum, tungsten alloy, and plastic material loaded with a radiopaque filler.

Filter frame 27 includes one or more struts 34. Struts 34 are adapted and configured to have at least a portion thereof disposed within grooves 20. In addition, struts 34 may include flared proximal ends 36 that may extend proximally of holding receptacle 18 when struts 34 are disposed within grooves 20. According to this embodiment, flared proximal ends 36 may serve to help hold struts 34 in grooves 20 and otherwise prevent distal movement of struts 34 (and, thus, movement of filter 26) relative to adaptor 10.

A cap 38 can be slidably disposed along the length of adaptor 10. Cap 38 may be generally conical and be adapted and configured to slide along adaptor 10 until cap 38

engages holding receptacle 18. Sliding cap 38 over holding receptacle 18 couples filter 26 to guidewire 28.

If adaptor 10 is placed on wire 28 as shown in Figure 2, but is not fixedly attached thereto, it will be free to rotate and slide along the wire. This floating filter type design allows wire 28 to be rotated or translated without rotating or translating filter 26 when deployed in a body lumen.

Figure 3 is a perspective view of tubular adaptor 10 and filter 26 wherein cap 38 is disposed over a portion of struts 34 to couple filter 26 to guidewire 28. When disposed over holding receptacle 18, cap 38 may be fixed in place, for example by adhesive. Alternatively, cap 38 may be fixed by crimping, laser or heat bonding, etc. In an exemplary embodiment, cap 38 may include a deflectable flange adapted to mate with a ring shank of holding receptacle 18. A number different methods may be used to fix cap 38 relative to holding receptacle 18 without departing from the spirit of the invention.

Having flared proximal ends 36 of struts 34 may help to securely couple filter 26 to guidewire 28. According to this embodiment, flared proximal ends 36 would substantially prevent struts 34 from being displaced from grooves 20. In an alternate embodiment, struts 34 may have a second set of flared surfaces spaced from ends 36 a distance greater than or equal to the length of channels defined by grooves 20. According to this embodiment, struts 34 may be fixed within grooves 20 by multiple sets of flares on opposite ends of grooves 20. Moreover, grooves 20 may include one or more depressions and struts 34 may include an equal number of projections. According to this embodiment, the projections and the depression would be designed to mate and, thus, couple filter 26 to guidewire 28.

Figure 4 is a partial cross-sectional view of an alternate adaptor 110 that is essentially the same in form and function as adaptor 10 but further including one or more bearings 140 disposed proximate seal tube 122. More particularly, bearings 140 may be disposed near where holding receptacle 118 and cap 138 couple struts 34 to adaptor 110. Bearings 140 allow adaptor 110 to rotate (along with filter 26) about seal tube 122. Analogously, bearings 140 may allow guidewire 28 and seal tube 122 (i.e., when guidewire 28 and seal tube 122 are coupled) to rotate within adaptor 110 without altering the position of filter 26.

Seal tube 122 is essentially the same as seal tube 22 described above and includes lumen 116. The embodiment illustrated in Figure 4 also shows seal tube 122 as being truncated at holding receptacle 118 (as opposed to seal tube 22 shown in Figure 1-3). It can be appreciated that the truncated version of seal tube 122 is equally applicable the embodiments shown in Figures 1-3 and that the elongated seal tube 22 of Figures 1-3 could be used in Figure 4.

It should be understood that this disclosure is, in many respects, only illustrative. Changes may be made in details, particularly in matters of shape, size, and arrangement of steps without exceeding the scope of the invention. The invention's scope is, of course, defined in the language in which the appended claims are expressed.